

Chapter 2. Introduction

Relationship to UMR/IWW System Navigation Feasibility Study

Navigation on the Mississippi River and the Illinois Waterway has proven to be an efficient and cost-effective means of transporting a variety of commodities. It is a vital part of our national economy. The importance of the Upper Mississippi River-Illinois Waterway as a shipping artery is reflected in the continual increase in tonnage shipped on the system. According to a recent study (Jack Faucett Associates, 1997), the aggregate traffic on the Upper Mississippi River is forecasted to increase slightly over 90 percent from 1991-93 to 2050. The comparable increase forecasted for the Illinois Waterway is slightly less, about 86 percent. Many of the locks were designed to accommodate a fraction of the current traffic using this transit system. All but two of the locks (Keokuk, Lock & Dam 19; and Melvin Price, Lock & Dam 26) on the system are 600 feet long; whereas many of the tows using the rivers are approximately 1200 feet long.

The Upper Mississippi River/Illinois Waterway (UMR/IWW) is also a national treasure in terms of its ecosystem and recreational values. Any improvements to the existing navigation system designed to move traffic through the system more efficiently must take into consideration their impact on the environment and recreation.

In view of all of these considerations, the “Upper Mississippi River/Illinois Waterway System Navigation Feasibility Study” is being conducted to determine how best to manage the Upper Mississippi River/Illinois Waterway system in a manner that balances navigational, environmental, and recreational needs.

The Upper Mississippi River/Illinois Waterway Bank Erosion Study is one of many studies being conducted to assess potential environmental impacts associated with possible improvements to the navigation system and will ultimately be included as supporting documentation for the System Environmental Impact Statement for the Upper Mississippi River/Illinois Waterway System Navigation Feasibility Study.

Project Overview

Hydraulics of flow, secondary circulation, turbulence characteristics, tow operation, increased commercial and recreation traffic, channel modifications, and or wind-generated waves and geotechnical processes to include piping, rapid recessional loading, cleft pressures, and

slaking may all result in increased bank erosion or migration of existing bank erosion sites. Bank erosion, in turn, can result in the loss of cropland, forest, pasture, and residential, municipal, wetland, and riparian zones. This affects plant and animal uses of aquatic and terrestrial bankline areas, cultural resources and historic properties located along bankline areas, and human uses of bankline areas. In addition to direct erosion impacts to the bankline, eroded soils, fills, and recently deposited alluvium from the banks may increase sedimentation of the backwater areas and side channels, increase the dredging maintenance requirement, may increase water treatment costs and adversely affect the operating life of machinery, may affect shellfish quality, and may affect recreational uses and aesthetic qualities of the river ecosystem.

Rivers erode, transport, and deposit sediments from the back of the bank or the bank of a channel area. If banks are protected, related impacts could include channel bed degradation.

Streambank erosion is an extremely complex process, but there are primarily three types of causative mechanisms in the bank erosion process (USACE, 1981). These are: 1) mechanisms that displace soil particles from the bank surface; 2) mechanisms that destabilize the internal structure of the bank, resulting in failure of soil blocks or entire segments of the bank; and 3) mechanisms that transport the displaced soil particles or failed soil blocks away from the bank. Unless the stream can remove the displaced soil particles or the failed soil blocks through transport processes, the bank will tend toward a stable or aggrading condition. Soil displacement mechanisms include abrasion by ice and debris, biological processes, chemical processes, flow velocity, freeze-thaw, gravity, human activities, precipitation, waves, and wetting/drying processes. Internal soil failure mechanisms include slope instability, piping, liquefaction, tension cracks, swelling and shrinking, stresses from rapid recessional loading, cleft pressure, and surcharge. Transport mechanisms include gravity, human action, and water flow. A detailed discussion of the causative physical processes that produce these bank erosion conditions is presented in appendix A, “Upper Mississippi River System Bank Erosion Literature Study”.

As part of the environmental impacts assessment effort for the Upper Mississippi River/Illinois Waterway System Navigation Feasibility Study, a Bank Erosion Plan of Study was included in the Initial Project Management Plan (IPMP). It was determined that changes in bankline as a result of bank erosion could impact the riparian habitat of fish and wildlife and cultural resources along the bankline. It is also important to understand these processes as they relate to the potential loss of land and its effect on property ownership, structural integrity, etc. Therefore, the study proposed an investigation of the extent of existing bank erosion, the probable

processes that cause bank erosion, and the potential for further bank erosion, particularly as related to navigation traffic.

Six tasks were identified in the IPMP for this effort with a decision point after Task 3. Task 1 was to conduct a literature search to identify applicable and available references for use in decision making in the other tasks; this literature review is presented in appendix A. Task 2 was to conduct a system-wide inspection of the Upper Mississippi River/Illinois Waterway systems with a multi-disciplinary team to quantify the present extent of bank erosion and to attempt to discern the most probable causes of that erosion. Based on the pertinent literature and the field inspections, Task 3 involves qualitatively assessing the relative significance of commercial navigation to existing bank erosion. If navigation effects on bank erosion cannot be discerned from other causative factors, or if navigation effects are not considered significant, the bank erosion study will terminate. Otherwise, Tasks 4 and 5 will require some type of “modeling” effort to establish future conditions, with and without the project, based on projections of future navigation traffic growth; and Task 6 would be a final report. The specific scope of this study and report is to address Tasks 2 and 3 and to make a recommendation regarding Tasks 4 and 5.

Study Design

This study was designed to identify and describe riverbank conditions and bank erosion sites on the entire Upper Mississippi River/Illinois Waterway. It was designed also to identify the major erosion sites, inventory those bank sites, identify bank soils and sediments, and provide opinions as to the erosion and failure mechanisms at each location.

The literature review completed prior to this study was available for reference throughout the design and completion of this study. Also, an aerial reconnaissance survey of bank conditions was completed prior to initiation of this study. During the aerial reconnaissance survey, oblique color video imagery and color still photos of every bank-mile adjacent to the navigation channel on the Upper Mississippi River/Illinois Waterway were obtained. The video imagery and still photos were indexed to ground-coordinated positions using global positioning system (GPS) equipment onboard an aircraft. This information also was available for review at the onset of this study.

Scope of Work and Tasks

The scope of work for this study identified the following work tasks:

1. Review the bank erosion study literature review conducted by the U.S. Army Corps of Engineers Waterways Experiment Station (Maynard and Martin, 1996 - appendix A).
2. Develop a classification system for all significant bank erosion sites.
3. Review the aerial video imagery and available mapping for preliminary selection of at least 60 sites for detailed study and data collection during the boat reconnaissance survey.
4. Conduct a boat reconnaissance survey, with a multi-disciplinary study team, of the Upper Mississippi River/Illinois Waterway to document existing bank conditions. Field data will be collected from a minimum of 60 sites, and the team will provide opinions as to the erosion and failure mechanisms at each site.
5. Select five sites for detailed traffic impact studies — these studies were not done.
6. Prepare a report that includes a review of historical and technical information; a review of video photography and mapping, a detailed description of the classification system and resulting attribute database development; a report of the boat reconnaissance, including detailed descriptions of each of the approximately 60 sites selected for detailed investigations, opinions as to what initiated bank failure mechanisms and processes, a description of the five sites selected for detailed traffic impact studies and reasons why these sites were selected; opinions regarding the relative significance of bank failure and erosion mechanisms and navigation effects on bank erosion and failure; and complete mapping of all recorded eroding banks and photographs taken during the boat reconnaissance.
7. Prepare an electronic database file containing all bank erosion classification system attribute data collected for the approximately 60 sites selected for detailed investigations.

The scope of work required the study team to identify and describe riverbank conditions and bank erosion sites on the entire Upper Mississippi River System, including the Illinois Waterway. The study focused on the Upper Mississippi from the confluence with the Ohio River (River Mile, or RM 0) to the Upper St. Anthony Falls Lock (RM 854), and on the Illinois Waterway from Grafton, Illinois (RM 0), to Joliet, Illinois (RM 286).

The detailed scope of work for this study is contained in appendix B. Some deviation from the scope of work occurred during the study process, and these deviations are discussed in the appropriate locations throughout this report.

Past Studies

The literature review presented in appendix A addresses all literature found to be pertinent to the Upper Mississippi River/Illinois Waterway Bank Erosion Study. Several studies have been conducted on the Upper Mississippi River and the Illinois Waterway specifically to address commercial and recreational navigation impacts on bank erosion. Most notable of these are: Bhowmik and Schicht (1980); Bhowmik, Demissie, and Guo (1982); Hagerty (1988, unpublished); Spoor and Hagerty (1989); and Johnson (1994). These authors present a variety of opinions on the subject of bank erosion and the relative significance of navigation traffic-generated waves as an erosion mechanism.

References

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